The use of the 1710-1850 MHz frequency band is also subject to the provisions of Sections 8.2.47, which discourages the development of flight test telemetry and associated telecommand systems within this band, and 9.2.4 of the NTIA Manual which points out the requirement for coordination when requesting frequency assignments for fixed stations consisting of more than two interconnecting stations in various bands that include the 1710-1850 MHz band.

2200-2290 MHz Band

Internationally, the 2200-2290 MHz frequency range is allocated to Regions 1, 2, and 3 for fixed and mobile services on a primary basis, except in Region 1 where the mobile service is secondary to the fixed service. Further, it may also be used for space-to-Earth or space-to-space transmissions in the space research, space operations, and earth exploration-satellite services, subject to provisions of International Footnote 750. All the other international footnotes relevant to each region in the 1710-1850 MHz range are also applicable to each region in the 2200-2290 MHz range, as can be seen in TABLE 3-3.

Nationally, the 2200-2290 MHz frequency band is allocated to the fixed, mobile, and space research services on a primary basis. Also, space-to-Earth and space-to-space transmissions in the earth exploration-satellite and space operations services may be accommodated on a co-equal basis with the services having primary status in the band. The fixed and mobile services are restricted to the line-of-sight mode of operation. In addition, mobile service operation in the band includes aeronautical telemetry, but excluding flight testing of manned aircraft. The space research operations permitted in the band are the space-to-Earth and space-to-space transmissions. The current International and U.S. National Tables of Frequency Allocations for the 2200-2290 MHz frequency band is shown in TABLE 3-3. The associated footnotes applicable to the U.S. are included in the table.

As in the case of the 1710-1850 MHz band, the use of the 2200-2290 MHz band is also subject to provisions set by various sections of the NTIA Manual. For example, Section 8.2.33 provides a guideline for the selection of sites and frequencies for earth and terrestrial stations in the bands above one Gigahertz shared with equal rights by terrestrial and space radiocommunication services. Section 8.2.36 limits the power flux density at the Earth's surface from space stations in the space research, space operations, and earth exploration-satellite services operating in the 2200-2290 MHz band. Section 8.3.12 establishes the procedure for coordination of assignments for transmissions by terrestrial stations located within the coordination area of a receiving earth station. TABLE 3-4 shows a list of existing and coordinated receiving earth stations operating in the 2200-2290 MHz band. TABLE 3-4 includes the state location, site coordinates, and agency operating the station, including those for receiving earth stations operating in the 2200-2300 MHz band.

TABLE 3-3

CURRENT INTERNATIONAL AND U.S. NATIONAL TABLES OF FREQUENCY ALLOCATIONS FOR THE 2200-2900 MHz BAND

INTERNATIONAL			UNITED STATES				
Region 1 MHz	Region 2 MHz	Region 3 MHz	Band MHz 1	National Provisions 2	Government Allocation 3	Non-Government Allocation 4	Remarks 5
1710-2290 FIXED Mobile 722 744 746 747 748 750	1710-2290 FIXED MOBILE 722 744 745 746 747 748 749 750		2200-2290	US303	FIXED (LOS *Only) MOBILE (LOS Only including aeronautical telemetering, but excluding flight testing of manned aircraft) SPACE RESEARCH (Space-to-Earth) (Space-to-space) G101		*Line of sight

FOOTNOTES APPLICABLE TO THE U.S.

U.S. Footnote(s):

US303--In the band 2285-2290 MHz, non-Government space stations in the space research, space operations and earth exploration-satellite services may be authorized to transmit to the Tracking and Data Relay Satellite System subject to such conditions as may be applied on a case-by-case basis. Such transmissions shall not cause harmful interference to authorized Government stations. The power flux density at the Earth's surface from such non-Government stations shall not exceed -144 to -154 dBW/m^2/4 kHz, depending on angle of arrival, in accordance with ITU Radio Regulation 2557.

Government Footnote(s):

G101--In the band 2200-2290 MHz, space operations (space-to-Earth) and (space-to-space), and earth exploration-satellite (space-to-Earth) and (space-to-space) services, may be accommodated on a co-equal basis with fixed, mobile and space research services.

TABLE 3-4

RECEIVING EARTH STATIONS IN THE 2200-2300 MHz BAND

FREQUENCY LOCATION	COORDINATES	SITE COORDINATES (Latitude/Longitude)	NOMINAL COORDINATION DISTANCE* (Statute Miles)	AGENCY
2200-2290	Goldstone, CA	35 20 30 N/116 52 25 W	See APPENDIX C (Figure C-1)	NASA
	Greenbelt, MD	38 59 55 N/076 50 34 W	See APPENDIX C (Figure C-2)	NASA
	Guam	13 18 33 N/144 44 04 E	935	NASA
	Kauai, HI	22 07 31 N/159 40 03 E	935	NASA
	Merritt Island, FL	28 30 30 N/080 41 37 W	See APPENDIX C (Figure C-3)	NASA
	Rosman, NC	35 12 00 N/082 52 19 W	See APPENDIX C (Figure C-4)	NASA
	Fairbanks, AK	64 58 38 N/147 30 54 W	See APPENDIX C (Figure C-5)	NASA
	Shirley Bay, Ontario	45 20 56 N/075 53 23 W	See APPENDIX C (Figure C-6)	Canada
2200-2300	Andersen AFB, Guam	13 36 48 N/144 51 12 E	See APPENDIX C (Figure C-7)	AF
	Buckley Field, CO	39 43 XX N/106 46 XX W	366	AF
	Cape Canaveral, FL	28 25 41 N/080 36 28 W	366(land),992(Sea)	AF
	Fairchild AFB, WASH	47 30 XX N/118 10 XX W	353(land),945(Sea)	AF
	Kaena Pt., HI	21 34 18 N/158 16 34 W	See APPENDIX C (Figure C-8)	AF
	New Boston, NH	42 56 54 N/071 38 24 W	See APPENDIX C (Figure C-9)	AF
	Shemya, AK	52 43 XX N/174 07 XX E	254(land),589(Sea)	AF
	Vandenberg AFB, CA	34 29 24 N/120 31 54 W	See APPENDIX C (Figure C-10)	AF
	Onizuka AFB, CA	37 24 17 N/123 59 03 W	Not Available	AF
	Camp Parks, CA	37 43 59 N/122 07 13 W	Not Available	AF
	Colorado Springs, CO	38 48 30 N/104 30 00 W	Not Available	AF
2290-2300	Goldstone, CA	35 25 29 N/116 53 24 W	See APPENDIX C (Figure C-11)	NASA

*The nominal coordination distance shown is the maximum coordination distance for flat terrain on an overland path, or, if applicable, on an over-water path. It does not take into account the effect of possible terrain shielding.

The other sections of the NTIA Manual that are deemed applicable to the 2200-2290 MHz band are Sections 8.2.25, 8.3.13, 8.3.14, 8.3.15, and 9.2.4. These sections were previously discussed.

TECHNICAL STANDARDS

The general technical standards of Chapter 5 of the NTIA Manual contains minimum performance requirements and design objectives applicable to transmitters, receivers, and antennas used in government radio stations. As of May 1990, stations transmitting in the 1710-1850 MHz and 2200-2290 MHz bands are required by Section 5.1 through 5.1.3 to have frequency and spurious tolerances as shown in TABLE 3-5.

TABLE 3-5

FREQUENCY TOLERANCE AND UNWANTED EMISSION TECHNICAL STANDARDS FOR THE 1710-1850 MHz AND 2200-2290 MHz BANDS

STATION TYPE	FREQUENCY TOLERANCE (PPM)[a]		LEVELS OF UNWANTED EMISSIONS (See Notes)	
	1710-1850 MHz Band	2200-2290 MHz Band	1710-1850 MHz Band	2200-2290 MHz Band
FIXED				
< 100 watts	30	30	I, M	I, J, M
> 100 watts	10	10	I, M	I, J, M
LAND	20[b]	20[b]	I	I, J
MOBILE	20[b]	20[b]	I	I, J
EARTH	20	20	N	N
SPACE	Not Applicable	20	Not Applicable	N

[a]Parts Per Million
[b]The indicated tolerance applies to new equipment after January 1, 1987. A tolerance of 30 ppm applies to other equipment.

Levels of Unwanted Emissions Notes

Note I — The standards for spurious signals which limit the mean power of any emission supplied to the antenna transmission line, as compared with the mean power of the fundamental, shall be in accordance with the following:

1. On any frequency removed from the assigned frequency by more than 75 percent, up to and including 150 percent of the authorized bandwidth, at least 25 decibels attenuation;

2. On any frequency removed from the assigned frequency by more than 150 percent, up to and including 300 percent of the authorized bandwidth, at least 35 decibels attenuation; and

3. On any frequency removed from the assigned frequency by more than 300 percent of the authorized bandwidth, for transmitters with mean power of 5 kilowatts or greater, at least 80 decibels attenuation, and for transmitters with mean power less than 5 kilowatts, at least 43 plus 10 log (mean power of the fundamental in watts) decibels attenuation (i.e., 50 microwatts absolute level).

Note J — Emission Levels for telemetering stations, excluding those for space radiocommunications, in the bands ...2200-2290... MHz are contained in Part 5.8 [NTIA Manual].

Note M — Emission levels applicable for the Fixed Services in the ...1710-1850 MHz and 2200-2290 MHz frequency bands are contained in Section 5.4.2... [NTIA Manual].

Note N — Emission levels for space and earth stations in the Space Services are contained in Section 5.7 [NTIA Manual].

A summary of technical standards applicable to the fixed service in the 1710-1850 MHz and 2200-2290 MHz bands is shown in TABLE 3-6 (see Refs. 1, 3, and 4).

Along with the above technical standards, the Telemetry Working Group of the Range Commanders Council (RCC) has proposed standards to foster the compatibility of telemetering transmitting, receiving and signal processing equipment at all the test and evaluation ranges under the cognizance of the RCC (Telemetry Standards, Document 106-77, see Ref. 4).[a] This Inter-Range Instrumentation Group (IRIG) standard is used as a guide by managers and users of telemetry in the 2200-2300 MHz band, at National, Service, or other DOD test ranges/facilities. These telemetry standards are intended to further the compatibility and interoperability of airborne transmitting equipment at these test ranges. To this end, the IRIG Steering Committee recommended that telemetering equipment at government test ranges conform to these standards (see Ref. 4).[b] The quality of terminal equipment, in general, will be raised by concentrating development on a minimum of system types. An equipment that deviates from these standards must be shown to be both technically necessary and economically feasible. To ensure that the standards remain current, the Telemetry Working Group reviews and revises them periodically.

FREQUENCY CHANNELING PLANS

There is no existing national frequency channeling plan for the 1710-1850 MHz band. In the band 2200-2290 MHz, 90 one-megahertz narrowband channels are designated, centered on 2200.5 MHz and each one-megahertz increment thereafter, through and including 2289.5 MHz. The use of emission bandwidths greater than 1 MHz is permitted, provided the assigned frequencies are centered on the center frequencies of narrowband channels. These channels

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[a] RCC - a group or committee basically composed of frequency management personnel from all DOD test ranges in the U.S. Among its many responsibilities are: frequency coordination within a test range or between test ranges; assessing the impact of a frequency use on other systems/equipment within a test range or between test ranges.

[b] IRIG - a group or committee under the cognizance of the RCC. Some of its responsibilities are to provide standards (e.g., telemetry standards) and system or equipment design to the RCC for all the test ranges in certain government bands (e.g., 138-144 MHz, 2200-2290 MHz, etc.).

TABLE 3-6
(page 1 of 2)

SUMMARY OF TECHNICAL STANDARDS APPLICABLE TO THE FIXED SERVICE IN THE 1710-1850 MHz AND 2200-2290 MHz BANDS
(See Refs. 1, 3, and 4.)

1. INTRODUCTION

Applicability:	Federal Gov't Fixed Service employing LOS, pt-to-pt and transportable except troposcatter.
Effective Date:	New Systems Jan. 1, 1979 All Systems Jan. 1, 1994

2. TRANSMITTING EQUIPMENT

Authorized Bandwidth(B_n):	Same as necessary bandwidth, see below
Emissions Outside of B_n :	Any emission removed from the assigned frequency by Δf shall be attenuated as follows:
Non-Digital	25 dB for $.5\ B_n < \Delta f \leq B_n$ 35 dB for $B_n < \Delta f \leq 2.5\ B_n$ X dB for $2.5 B_n < \Delta f$ with $43 \leq X \leq 80$
where:	$X = 43 + 10 \log P_m$ P_m = Mean Output Power in Watts
Digital	YdB for $.5\ B_n < \Delta f \leq 2.5\ B_n$ with $50 \leq X \leq 80$
where:	$Y = 35 + 0.8(P-50) + 10 \log B_n$ = Power in any 4 kHz band relative to mean power output P = Δf expressed as percent of B_n
Frequency Tolerance (Ft):	10 ppm for power > 100 W 30 ppm for power $\leq$ 100 W

3. RECEIVING EQUIPMENT

Noise Figure:	$\leq$ 9 dB
Selelctivity:	- 3 dB bandwidth (BW_3) commensurate with B_n + 2 Ft $BW_{60} \leq 5 \cdot BW_3$
Spurious Response:	- 60 dB
Frequency Stability:	$\leq 0.02\ BW_3$
Conducted Spurious Emissions:	$\leq$ - 85 dBW at antenna terminals

TABLE 3-6
(page 2 of 2)

4. ANTENNAS

Frequency band	Maximum beamwidth	Minimum suppression at angle in degrees from center line of mainbeam (dB)						
	(3 dB point)	5-10°	10-15°	15-20°	20-30°	30-100°	100-140°	140-180°
1710-1850 MHz[1]	10°	–	14	16	18	23	24	30
1710-1850 MHz[2]	8°	5	18	20	20	25	28	36
2200-2400 MHz	8.5°	4	12	16	16	24	25	30

5. SYSTEM LIMITATIONS

Power: Minimum amount required

EIRP: ≤ 80 dBm

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[1] These suppression levels could be met, e.g., by a 1.2 meter (4 foot) diameter parabolic antenna.

[2] This standard is applicable to new stations in the 1710-1850 MHz band placed in service after January 1, 1985, except for those located on the military test ranges specified in Section 7.17.1 and those limitations noted in Section 5.4.2.C. These suppression levels could be met, e.g., by a 1.83 meter (6 foot) diameter parabolic antenna.

are available for: a) telemetering from space research space stations irrespective of their trajectories; and, b) aeronautical telemetering, including telemetry associated with launch vehicles, missiles, and upper atmosphere research rockets. Such use is on a co-equal shared basis with fixed and mobile line-of-sight operations in the band conducted in accordance with the Government Table of Frequency Allocations. No provision is made in this band for the flight testing of manned aircraft, Paragraph 4.3.4.4 (NTIA Manual).

SECTION 4
SPECTRUM USAGE

1710-1850 MHz BAND

Background

The 1710-1850 MHz is the predominant federal medium capacity, line-of-sight, fixed service band. Fixed links are operated by federal agencies for voice, data, and/or video communications where commercial service is unavailable, excessively expensive, or cannot meet required reliability. Applications include law enforcement, military command and control networks, and control links for various power, land, water, and electric-power management systems. Other specified fixed links include video relay, data relay, and timing distribution signals.

Specific agency applications of the fixed service include: FAA remote data transmission in support of aviation, Army tactical radio relay systems to support an area-wide command and control network, Departments of Agriculture (DOA) and Interior (DOI) backbone links for control of land mobile radio systems necessary in fire fighting, law enforcement and disaster control within national forests and for provision of voice and data connections between sites where commercial service is not available (e.g., the DOA's Mendocino Microwave System in California), and Departments of Treasury and Justice microwave links related to law enforcement. The U.S. Customs Service (Treasury) operates a microwave link between the Hawaiian Islands which was reconfigured from the 7-8 GHz band to the 1710-1850 MHz band for the required reliability because of terrain considerations. The FAA also has a similar link.

One example of a wide area fixed network is the Department of Energy's use of this band for supervision, control, and protection of power administration operated electrical power transmission systems and activities supporting nuclear weapons development. Power administration microwave must be capable of carrying hundreds of radio channels per system. The channels are used for high speed relaying, supervisory control, load control, telemetering, data acquisition, land-mobile radio dispatching, operations and maintenance. The nuclear test facilities backbone microwave systems serve sites at greater than 16 km (10 miles) and are more efficient in this band than in lower or higher bands. This band also allows for a greater range capability for robot control and video requirements. The present system connects all Federal Government power marketing control facilities in the Western half of the United States. Common

equipment exists with the non-government sector allowing interconnectivity for critical communications dealing with all aspects of generating and distributing power.

The Army uses the band primarily for establishing command and control network using radio relay and for a variety of applications, including target scoring, various microwave systems, instrumentation systems, robotic video and data links, and aeronautical data links. There are over 50 Army unique systems which operate in this band. The primary use of the band is for Army tactical command and control for area-wide network. The 1710-1850 MHz band propagation characteristics are essential for tactical nodal connectivity. Radio relay connectivity links various subordinate, lateral and strategic headquarters, functional and component nodes into an integrated area-wide network. Congestion and use of the band are heavy in proximity to Army post and training areas.

This band is also used for a variety of mobile applications, including airborne telemetry, telecommand, automated target scoring, and air combat maneuvering instrumentation. An example is the Navy's Tactical Aircrew Combat Training System which uses at least 22 discrete frequencies distributed across the entire band. Many military aeronautical mobile systems depend on frequencies in this band. The AF and Navy use this band heavily for their air-air and air-ground video and data links. Border surveillance through the use of aerostats is supported by narrowband uplink and downlink telemetry transmissions.

The Air Force also uses the band for space telemetry, command and control. Uplink frequencies between 1750 and 1850 MHz are heavily used in certain locations in conjunction with a 2200-2290 MHz downlink. Telemetry and telecommand and control of the NASA Space Shuttle is conducted on space-to-space links in this band.

This band is also used by the U.S. Coast Guard (USCG) for vessel traffic safety systems, in support of the VHF National Distress System, and remote distress and safety communications and control networks.

Radio astronomy observations are made of the 1720.530 MHz spectral line of the OH molecule. These observations are crucial to understanding the interstellar medium and star formation and other universal phenomenon.

In addition to the above, there are some future requirements identified by some agencies. For example, the Federal Aviation Administration (FAA) will need approximately 400 frequency assignments for the low density radio communication link (LDRCL) system. The FAA planned

to deploy 311 LDRCL systems all over the U.S. to support the nation's air traffic control operations.

TABLE 4-1 is a summary of some of the technical parameters for systems in the 1710-1850 MHz band. The table gives the percentages related to the emission bandwidth power and transmitter antenna gain of equipments allocated to the various services in the band. The table also lists the different station classes for the various services currently in the band.

Spectrum Usage

A combined total of 5539 frequency assignments are currently authorized in the GMF in the 1710-1850 MHz band, and out of these assignments about 4840 (87%) are in the fixed service. The total assignment count excludes temporary assignments used by the Army to support their area-wide command and control network system. At present, 22 agencies are authorized to operate in the 1710-1850 MHz band. A list of these agencies, and a summary count of their respective frequency assignments' station classes are shown in TABLE 4-2. Agencies with less than 10 assignments are grouped into the "others" category in the table. The total station classes (5753) count is further broken-down to total count per service with the respective percentages. Note, however, that the total number of frequency assignments is fewer than the total number of station classes. This is because there can be one, two, or more station classes per assignment.

The geographical distribution of authorized assignments in 1710-1850 MHz band is shown in Figure 4-1. The shaded portions of the map represent the areas of heavy concentration. As can be seen, this band is heavily and widely used nationally, with the exception of the mid and extreme northeastern portions of the country. The frequency assignment congestion is evident in most states of the western portion of the U.S.; in particular, the States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Washington. A frequency assignment distribution per state in the 1710-1850 MHz band is given in Figure 4-2. The ordinate delineates the number of assignments per state, as featured by the shaded column. Figure 4-2 also shows the total number of operating transmitters in the 1710-1850 MHz band per state as illustrated also by the shaded columns.

For the past 11 years, the usage of the band has increased almost five-fold -- from about 1250 assignments in December 1978 (see Ref. 3) to 5539 assignments in March 1990 [GMF, March 1990]. The growth increase which represents an average assignment growth rate of about 400 new assignments per year for 11 years, could be attributed solely to the fixed systems which have grown from a mere 657 assignments in December 1978 to 4840 in March 1990.

TABLE 4-1

SUMMARY OF PARAMETERS FOR SYSTEMS IN THE 1710-1850 MHz BAND

Aeronautical Mobile Service

FA - Aeronautical
FAD - Telecommand Aeronautical
MA - Aircraft
MAD - Telecommand Aircraft

Emission Bandwidth (BDW)	
0 - .9 MHz	7%
1 - 3 MHz	60%
5 - 35 MHz	33%

Power (PWR)	
1 - 5 Watts	61%
10 - 20 Watts	12%
25 - 50 Watts	27%

Tx Antenna Gain (XAD)	
0 - 10 dBi	70%
13 - 41 dBi	20%
NO ENTRY	10%

Land Mobile Service

FB - Base Station
ML - Land Mobile
MLP - Land Mobile Portable

Emission Bandwidth (BDW)	
6 - 10 MHz	20%
10 - 20 MHz	72%
20 MHz	8%

Power (PWR)	
.1 - 5 Watts	76%
10 - 20 Watts	24%

Tx Antenna Gain (XAD)	
0 - 2 dBi	76%
17 - 19 dBi	12%
NO ENTRY	12%

Mobile Service

FL - Land
FLD - Telecommand Land
FLE - Telemetering Land
FLEA - Aeronautical Telemetering Land
FLEB - Flight Telemetering Land
FLEC - Surface Telemetering Land

Emission Bandwidth (BDW)	
387 - 700 kHz	6%
1.7 - 7.1 MHz	93%
25 MHz	1%

Power (PWR)	
2.5 - 5 Watts	89%
15 - 20 Watts	11%

Tx Antenna Gain (XAD)	
0 - 3 dBi	83%
4 - 8 dBi	6%
12 - 30 dBi	11%

MO - Mobile
MOD - Telecommand Mobile
MOE - Telemetering Mobile
MOEA - Aeronautical Telemetering Mobile
MOEB - Flight Telemetering Mobile
MOEC - Surface Telemetering Mobile

Emission Bandwidth (BDW)	
.2 - 3 MHz	34%
6 - 20 MHz	57%
25 - 70 MHz	9%

Power (PWR)	
.001 - 5 Watts	55%
8 - 20 Watts	43%
25 - 50 Watts	2%

Tx Antenna Gain (XAD)	
0 - 4 dBi	18%
5 - 30 dBi	10%
NO ENTRY	72%

Fixed Service

FX - Fixed
FXD - Telecommand Fixed
FXE - Telemetering Fixed
FXH - Hydrologic and Meteorological Fixed
AX - Aeronautical Fixed

Emission Bandwidth(BDW)	
40 - 810 kHz	18%
1 - 8.1 MHz	69%
10 - 50 MHz	13%

Power (PWR)	
.01 - 1 Watt	51%
1 - 10 Watts	42%
14 Watts - 10 Kilowatts	7%

Tx Antenna Gain (XAD)	
0 - 20 dBi	7%
22 - 43 dBi	92%
NO ENTRY	1%

Permitted under Footnote G42

TD - Space Telecommand Earth
TK - Space Tracking Earth

Emission Bandwidth(BDW)	
0 - 800 kHz	10%
1 - 5 MHz	83%
10 - 108 MHz	7%

Power (PWR)	
.0125 -75 Watts	27%
132 - 300 Watts	3%
1 Kilowatt - 18 Kilowatts	70%

Tx Antenna Gain (XAD)	
0 - 14 dBi	10%
20 - 43 dBi	70%
NO ENTRY	20%

TABLE 4-2

SUMMARY COUNT OF STATION CLASSES PER AGENCY AND SERVICE IN THE 1710-1850 MHz BAND, AS OF MARCH 1990

Agencies and Totals per Agency[a]	Fixed Service	Mobile Service	Aeronautical Mobile Service	Land Mobile Service	No Specific Service	
					Space	Experimental
A 1373 (23.9%)	1373					
AF 829 (14.4%)	226	68	77		333	125
AR 797 (13.9%)	733[b]	23	4	20		17
C 17 (0.3%)	17					
CG 147 (2.6%)	147					
DOE 653 (11.3%)	647	1	2	3		
FAA 241 (4.2%)	239			1		1
FEMA 28 (0.5%)	28					
I 282 (4.9%)	281					1
J 723 (12.6%)	723					
N 450 (7.8%)	246	185	1			18
NASA 14 (0.3%)	3	8	1			2
T 41 (0.7%)	36	1	4			
TRAN 34 (0.6%)	32	2				
TVA 97 (1.7%)	97					
OTHERS 27 (0.5%)	19					8
Totals per Service	4847 (04.2%)	288 (5.0%	89 (1.5%)	24 (0.4%)	333 (5.8%)	172 (3.0%)

[a]The percentages of the total station classes per agency and service are rounded-off.

[b]Excludes temporary assignments for area-wide network system.

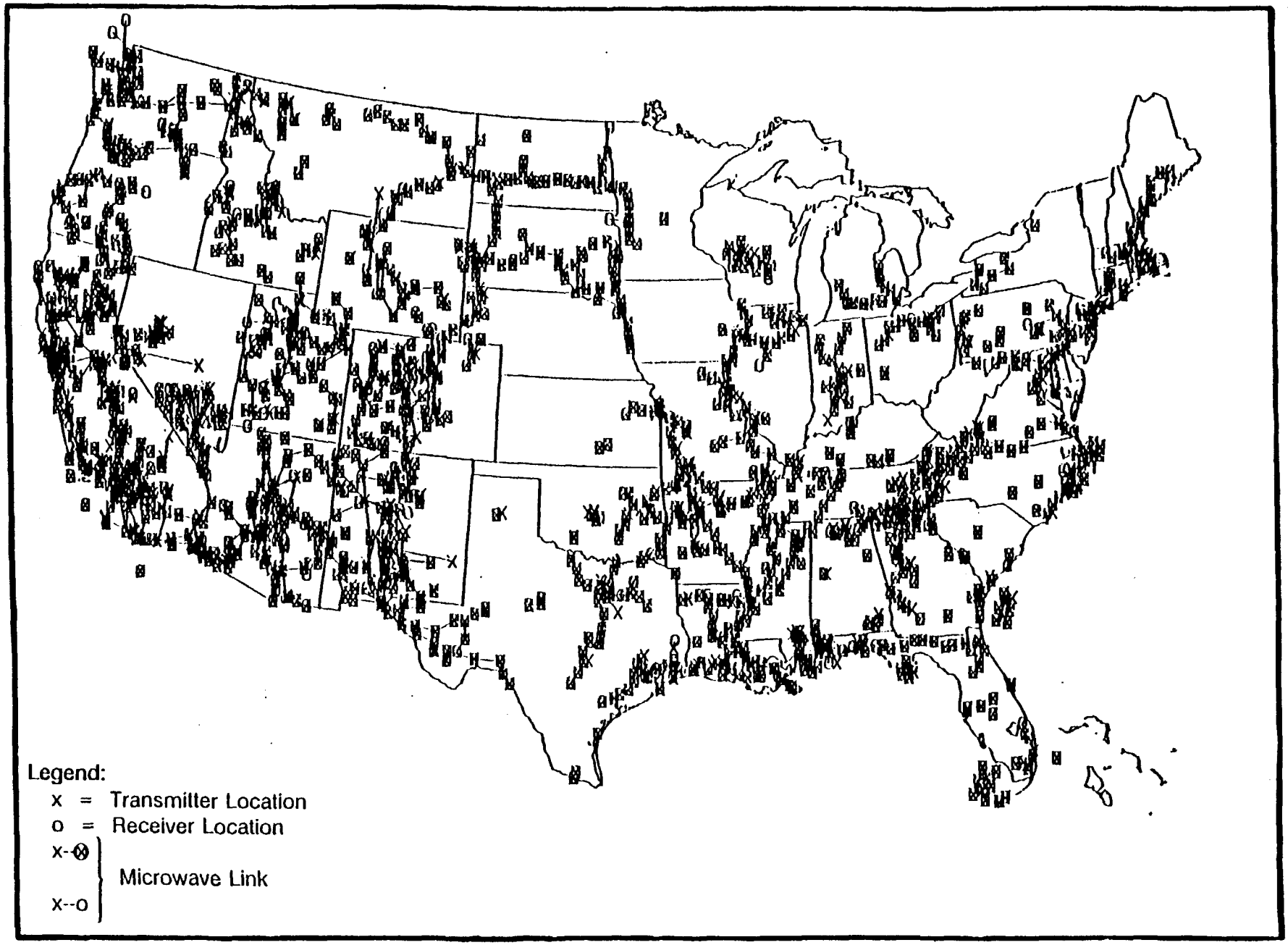

Figure 4-1. Geographic distribution of assignments in the 1710-1850 MHz band.

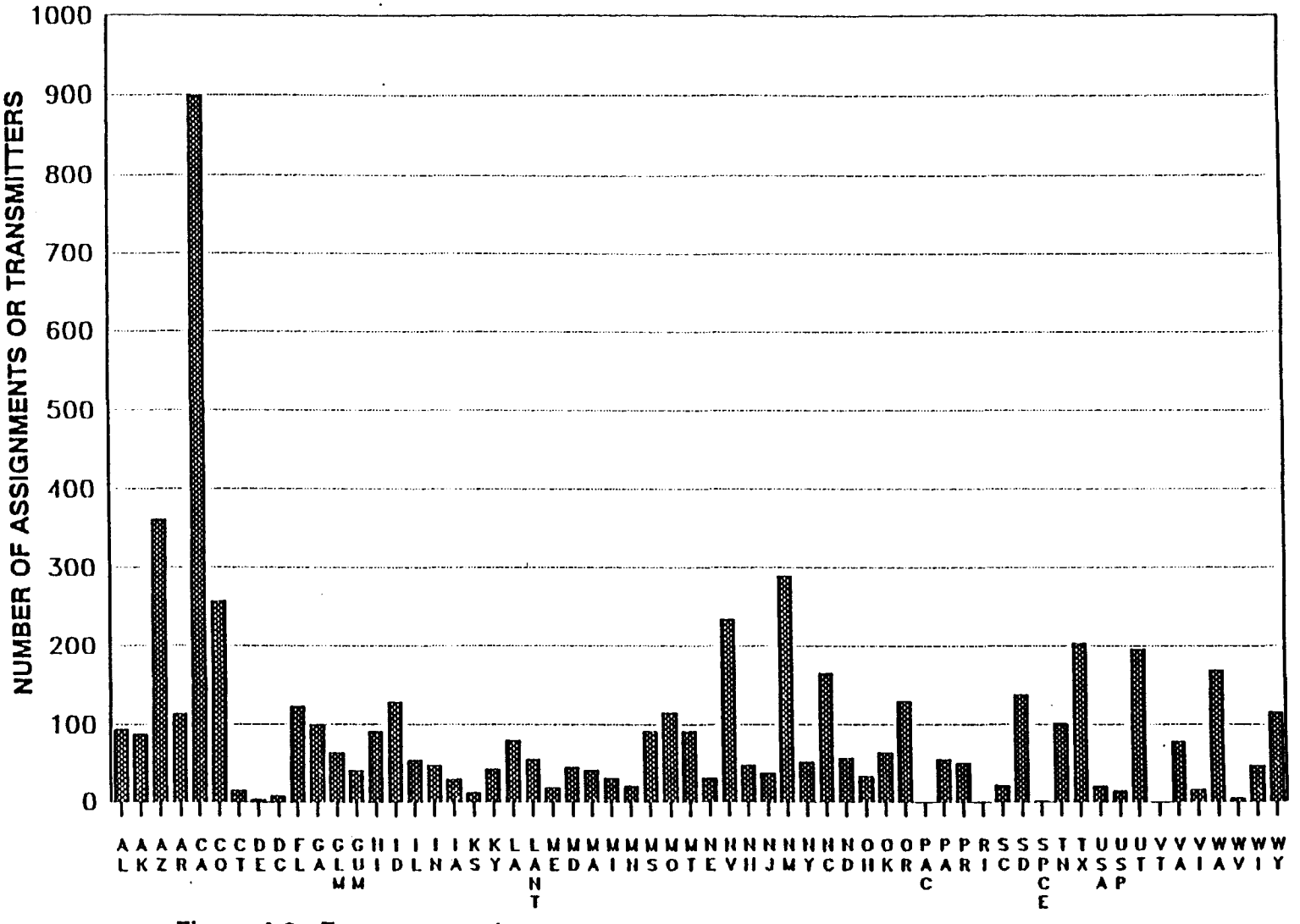

Figure 4-2. Frequency assignment distribution per state in the 1710-1850 MHz band.

Note:

GLM - Gulf of Mexico
GUM - Guam
LANT - Atlantic Ocean
PAC - Pacific Ocean
PR - Puerto Rico
SPCE - Space

USA - When transmitting and/or receiving in the 48 contiguous states of the U.S. and the District of Columbia, excluding Alaska and Hawaii.

USP - When transmitting and/or receiving throughout the U.S. (50 states and the District of Columbia), the Commonwealth of Puerto Rico, and the Territories and Trust Possessions, excluding the Territories of the Pacific Islands.

Figure 4-3 is a plot of the distribution of frequency assignment per one-megahertz bin across the entire 1710-1850 MHz band. The ordinate specifies the assignment count for every megahertz interval. As can be seen from Figure 4-3, the assignments are mostly concentrated at every 5 MHz interval starting at 1710 MHz. The channel occupancy at these designated frequency intervals varies from about 50 to 190 assignments. It should be noted that the distribution does not necessarily include the total number of equipments represented by these frequencies but, rather, just the assignment record count.

Spectrum Use Measure (SUM) in the Continental U.S. (CONUS)

NTIA's SUM model provides a technique for calculating the extent that the radio frequency spectrum is used by systems in a frequency band. The model can compute either of two measures of spectrum use. First, the spectrum use bandwidth (SUB) which measures the amount of spectrum made unavailable to a reference system by existing systems and, second, the spectrum use factor (SUF) which measures the probability that a location is unavailable to a reference system because of existing systems. A pictorial representation for each spectrum use measure is shown in Figures 4-4 and 4-5, SUB and SUF, respectively.

The SUB is the total spectrum bandwidth, in MHz, used by assigned systems at a particular test point. Figure 4-4 shows the values of SUB for the 1710-1850 MHz band in the CONUS. As can be seen, about a dozen states or portion of the states (e.g., California, Nevada, Utah, New Mexico, Florida, Alabama, North Carolina, Virginia, Maryland, Pennsylvania, and Delaware), including Washington, D.C., are heavily used. The reference system used to generate Figure 4-4 is a fixed system with a zero(0)dBi antenna gain.

The SUF is a value ranging from 0 to 1 that represents the fraction of spectrum resources used by systems assigned to a particular location, zero representing the least spectrum resources used. Figure 4-5 shows the SUF for the 1710-1850 MHz band in the CONUS using fixed as a reference system.

Both figures do not reflect frequency assignments whose latitude and/or longitude were not specified, fixed assignments where the distance between their respective transmitters and receivers is 100 miles or more, experimental, and nationwide assignments. Additional information on SUB and SUF as measures of spectrum use can be found in recent NTIA reports.[6,7]

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[6] Haines, R. H. and S. E. Litts, *The SUM Land Mobile Model: Application of the Spectrum Use Measure to the Land Mobile Service*, NTIA Technical Report TR-89-248, September 1989.

[7] Mayher, R. J., Haines, R. H., Litts, S.E., et. al., *The SUM Data Base: A New Measure of Spectrum Use*, NTIA Report 88-236, August 1988.

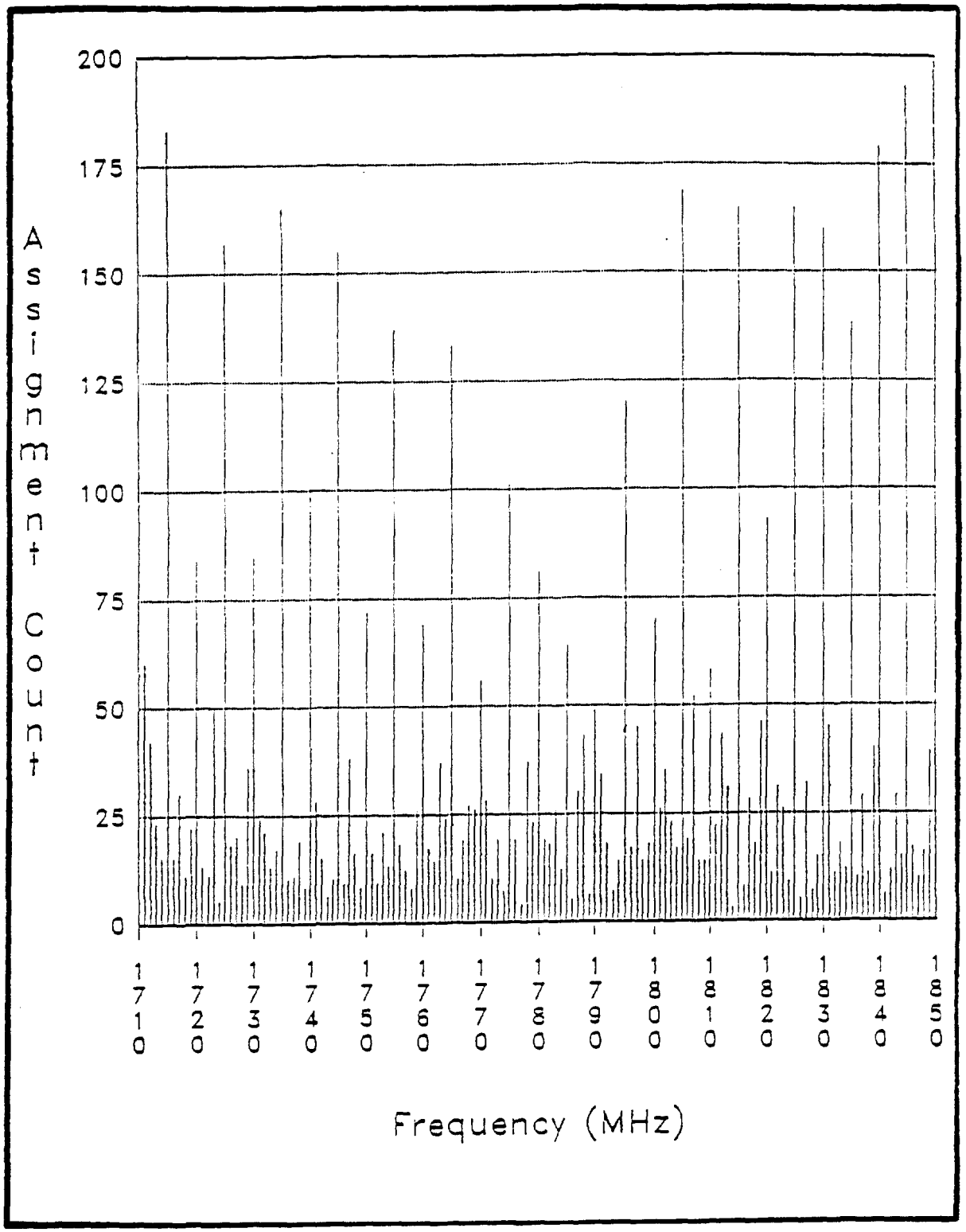


Figure 4-3. Frequency assignment distribution per Megahertz Bin in the 1710-1850 MHz band.

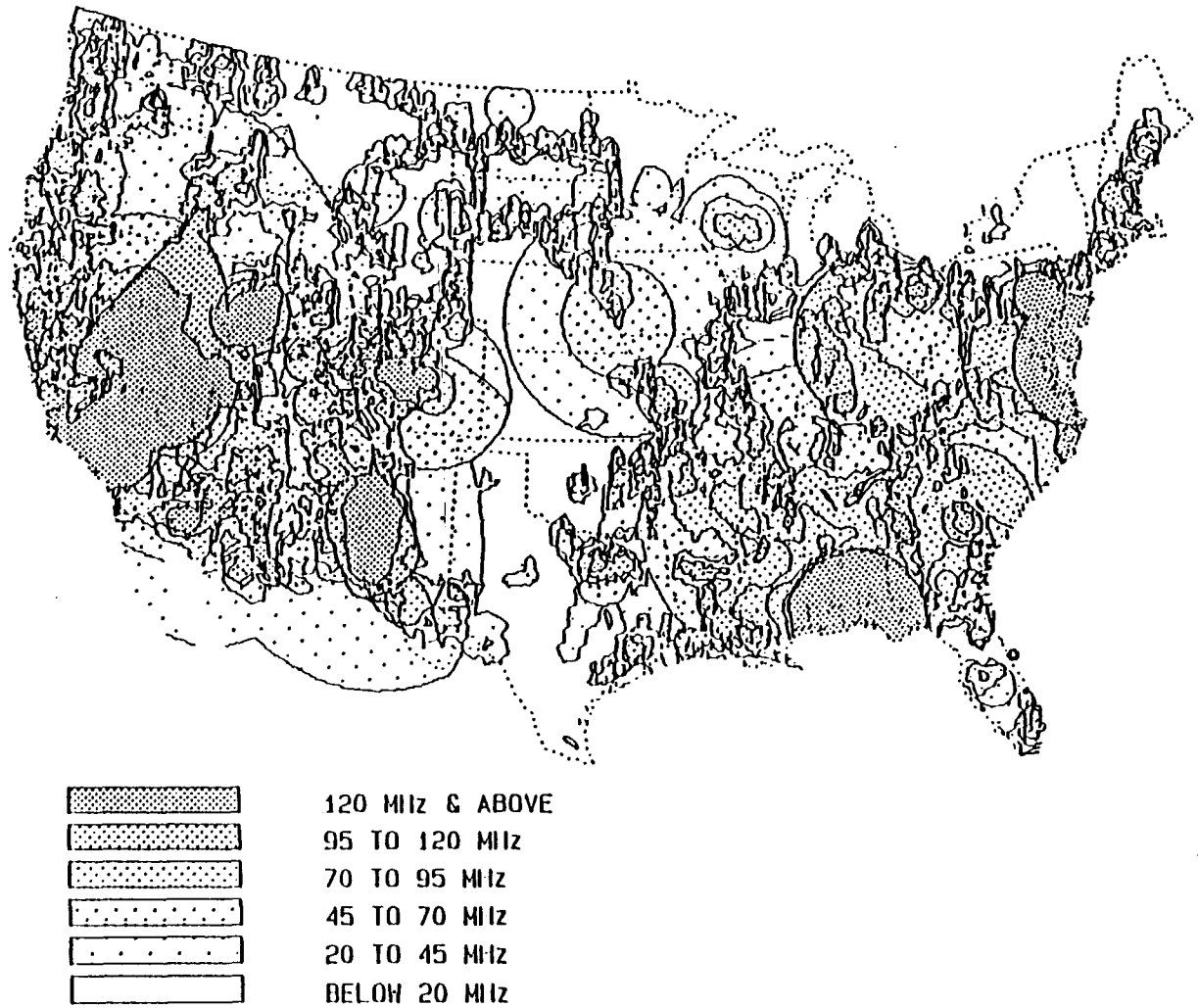


Figure 4-4. Areas of the United States with various ranges of Spectrum Use Bandwidth (SUB) values in the 1710-1850 MHz band.

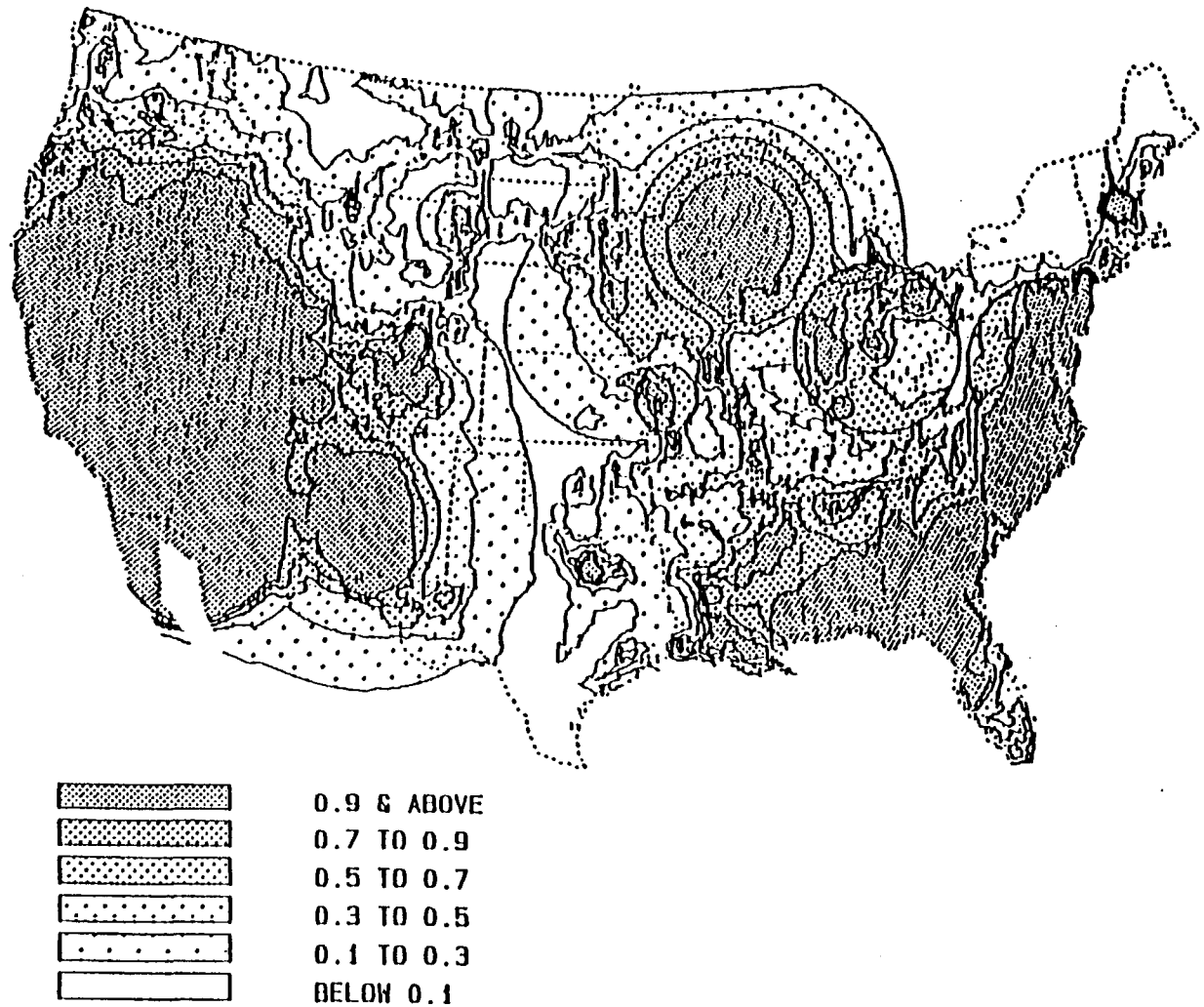


Figure 4-5. Areas of the United States with various ranges of Spectrum Use Factor (SUF) values in the 1710-1850 MHz band.

Emission Characteristics

As stated earlier, the 1710-1850 MHz band supports various types of systems with varying equipment emission characteristics. For example, the actual operational emission bandwidths of equipment in the band ranges from 40 kHz up to 70 MHz (excluding experimental equipments). The bulk of these bandwidths, however, occurs between 800 kHz and 10 MHz, as shown in Figure 4-6. The different ranges of bandwidths in which the occurrences were determined were chosen to accommodate all possible emission bandwidths currently used in the band.

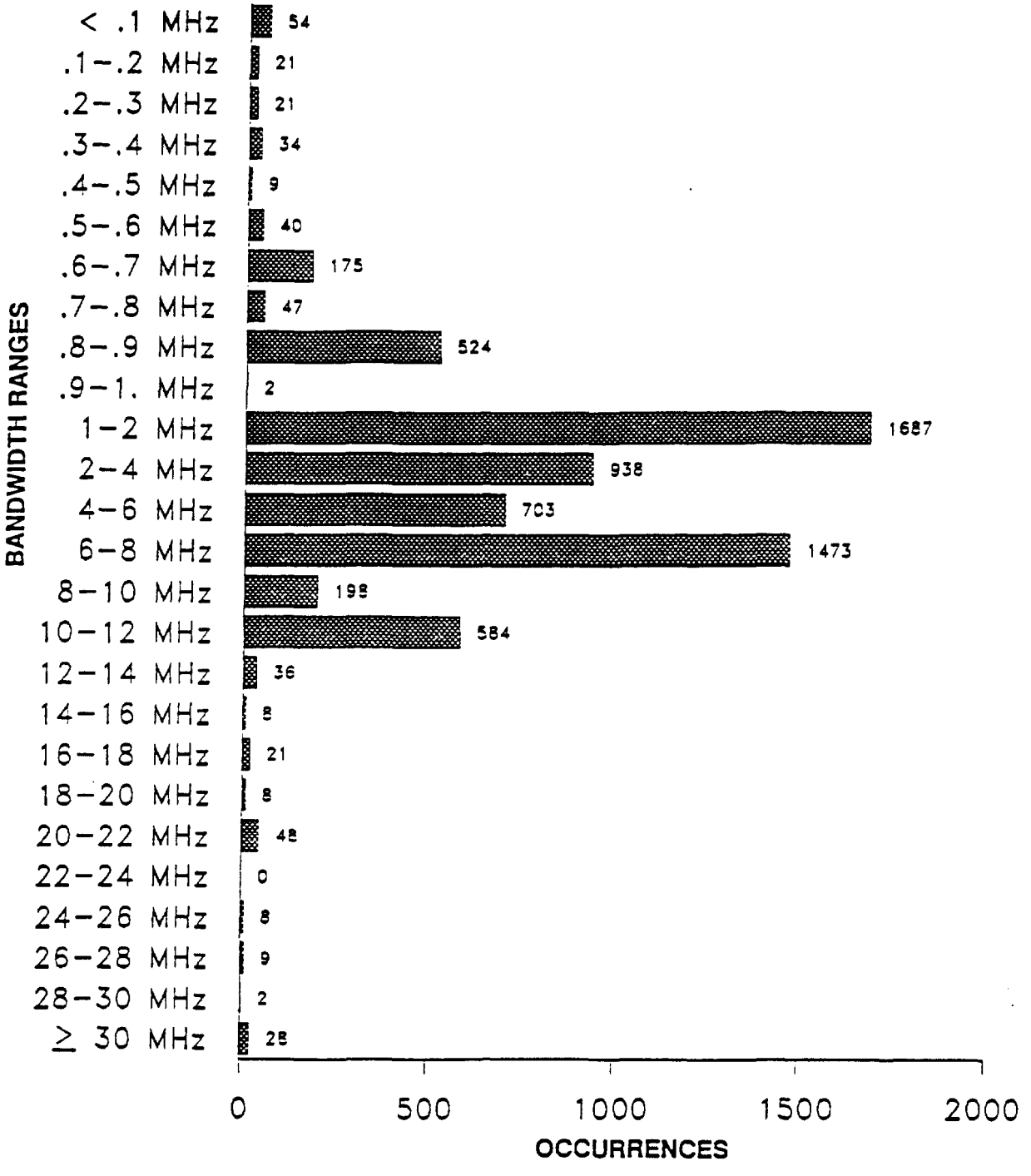
The most commonly used emission type in the band is F9W. It is a frequency modulation, composite system with one or more channels containing quantized or digital signals, together with one or more channels containing analog signals, and having the capability of transmitting all information simultaneously. In this band, this type of emission is usually associated with the fixed station class, although a handful of assignments are linked to the Mobile Service, in particular, aeronautical mobile. The predominant emission bandwidths, emission types, and station classes used by each agency in the 1710-1850 MHz band are shown in TABLE 4-3. The emission bandwidths listed in the table do not necessarily correspond to the emission types or the station classes listed along side them.

2200-2290 MHz BAND

Background

This band is predominantly used for federal terrestrial and space telemetry systems. Space applications include the NASA Ground Spaceflight Tracking and Data Network (GSTDN) and Tracking Data Relay Satellite System (TDRSS) and the Air Force Space Ground Link Subsystem (SGLS). These three systems provide the telemetry, telecommand and control for all Federal Government satellite systems and some activities have national security implications. Terrestrial telemetry is predominantly air-to-ground links for various operational and experimental systems.

GSTDN and TDRSS operations from 2200-2290 MHz are essential to NASA Earth exploration, space operations, and space research activities. This use includes space-to-Earth and space-to-space transmissions. Over 50 U.S. space missions and, consistent with international agreements, additional foreign missions will be supported by NASA in the next five years. There will be varying degrees of support from launch and orbital transfer to full-time data relay. These telecommunications links are also made available to private sector expendable



Note: The bandwidth occurrence values are inclusive of the lower limits of the various bandwidth ranges.

Figure 4-6. Distribution of emission bandwidths in the 1710-1850 MHz band.

TABLE 4-3

EMISSION DESIGNATORS AND STATION CLASS PREDOMINANTLY USED BY EACH AGENCY IN THE 1710-1850 MHz BAND

AGENCY	EMISSION BANDWIDTH (MHz)[a]	EMISSION TYPE[b]	STATION CLASS
AGRICULTURE	0.80 1.60	F9W	FX
AIR FORCE	0.60 3.00 5.00	F9W G7W G9D	FX TD TK
ARMY	0.80 1.20 3.50	CF3 F9D F9W	FX
COMMERCE	1.60 8.00	F1D F9W	FX
COAST GUARD	0.742 0.80	F8W F9W	FX
ENERGY	7.30 10.00	F9W	FX
FEDERAL AVIATION ADMINISTRATION	0.80 1.60	F9W	FX
FEDERAL EMERGENCY MANAGEMENT AGENCY	2.00 5.00	G7W F8W	FX
INTERIOR	0.80 1.60	F9W	FX
JUSTICE	2.00 8.00 10.00	F9W	FX
LABOR	0.25 5.75	C3F F3E	FX
NAVY	0.60 0.81 3.00 7.10	F2D G9D	FX FXE FLEB MOEA MOEB
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	4.00 10.00	F3F	MOEB
NATIONAL SCIENCE FOUNDATION	8.00	F1D	FXE
SMITHSONIAN INSTITUTE	0.80	F7D	FX
TREASURY	1.60 5.00	F9W	FX
TENNESSEE VALLEY AUTHORITY	8.00 10.00	F9W	FX
U.S. CAPITOL POLICE	0.04 8.00	F3E F3F	FX
U.S. POSTAL SERVICE	6.00	C3F	FX

[a]The emission bandwidths do not necessarily correspond to the emission types or station classes listed along side them.
[b]Defined in the NTIA Manual.

launch vehicle operations. The band also supports similar space-to-Earth and space-to-space telemetry, telecommand and control for military satellites through the Air Force SGLS system.

Terrestrial telemetry is heavily used in this band for such purposes as nuclear testing, airborne weapons testing, aircraft flight testing, and a wide variety of experimental and research projects. Most of this equipment was moved to this band during the 1970's, at significant expense to the Federal Government, to reaccommodate requirements in lower bands for other uses. Other mobile applications include Treasury narrowband uplinks and downlinks in conjunction with radar laden tethered balloons. These balloons are used in law enforcement and drug interdiction missions.

Fixed microwave systems are also in this band for control of land mobile radio systems to provide voice and data connections between sites where commercial service is not available, and where the 1710-1850 MHz band is saturated.

TABLE 4-4 is a summary of some of the technical parameters for systems in the 2200-2290 MHz band. The table gives the percentages related to the emission bandwidth, power, and transmitter antenna gain of equipments allocated to the various services for the band. The table also lists the different station classes for the various services currently in the band.

Spectrum Usage

A list of the agencies that are authorized to operate at this band, with their respective total number of frequency assignments' station classes and corresponding percentages relative to the combined total number of station classes in the 2200-2290 MHz band, is shown in TABLE 4-5. In addition, TABLE 4-5 shows the total number of station classes per service with the associated percentages. As can be noted, the DOD is the prominent user of the band. Of the 2582 total number of station classes, 1977 station classes or about 77% of the total usage is attributed to the military. The other two significant users of the band are the Department of Energy with 266 authorized station classes (10%) and the National Aeronautics and Space Administration with 184 station classes (7%). The Mobile Service, with 1322 station classes or 51% of the total usage, is the predominantly used service in the 2200-2290 MHz band followed by the "No Specific Service" (e.g., experimental, space tracking space, and space telemetering space assignments) with a combined total of 836 authorized station classes (32%). In terms of frequency assignments, this band has a total of 2170 authorized frequency assignments and 1366 are for mobile and space tracking and telemetering operations (63%).

TABLE 4-4
(page 1 of 2)

SUMMARY OF PARAMETERS FOR SYSTEMS IN THE 2200-2290 MHz BAND

Aeronautical Mobile Service

FA - Aeronautical
FAD - Telecommand Aeronautical
MA - Aircraft
MAD - Telecommand Aircraft

Emission Bandwidth (BDW)	
0 - 10 Hz	8%
2 - 3 kHz	31%
1.5 - 8 MHz	61%

Power (PWR)	
2 - 5 Watts	31%
10 - 20 Watts	54%
25 Watts	15%

TX Antenna Gain (XAD)	
0 - 2 dBi	53%
6 dBi	21%
NO ENTRY	26%

Land Mobile Service

FB - Base Station
ML - Land Mobile
MLP - Land Mobile Portable

Emission Bandwidth (BDW)	
10 Hz	50%
8 MHz	50%

Power (PWR)	
5 Watts	100%

TX Antenna Gain (XAD)	
2 dBi	50%
NO ENTRY	50%

Maritime Mobile Service

FB - Coast
FCB - Maritime Broadcast
FCD - Telecommand Coast
MS - Ship
MSP - Portable Ship
OD - Oceanographic Data
OE - Oceanographic Data *Interrogating*

Emission Bandwidth (BDW)	
1.5 MHz	72%
2 MHz	21%
9 MHz	7%

Power (PWR)	
20 Watts	72%
2 Watts	28%

TX Antenna Gain (XAD)	
0 dBi	72%
9 dBi	21%
3 dBi	7%

Mobile Service

FL - Land
FLD - Telecommand Land
FLE - Telemetering Land
FLEA - Aeronautical Telemetering Land
FLEB - Flight Telemetering Land
FLEC - Surface Telemetering Land

Emission Bandwidth (BDW)	
250 kHz	10%
300 kHz	24%
1.1 MHz	66%

Power (PWR)	
2 Watts	10%
5 Watts	66%
25 Watts	24%

TX Antenna Gain (XAD)	
3 dBi	10%
13 dBi	66%
5 dBi	24%

MO - Mobile
MOD - Telecommand Mobile
MOE - Telemetering Mobile
MOEA - Aeronautical Telemetering Mobile
MOEB - Flight Telemetering Mobile
MOEC - Surface Telemetering Mobile

Emission Bandwidth (BDW)	
.060 - .985 MHz	37%
1 - 10 MHz	61%
11.5 - 36 MHz	2%

Power (PWR)	
.01 - 10 Watts	90%
12 - 20 Watts	7%
30 - 100 Watts	3%

TX Antenna Gain (XAD)	
3 - 28 dBi	16%
0 - 2 dBi	45%
NO ENTRY	39%

TABLE 4-4
(page 2 of 2)

Fixed Service

FX - Fixed
FXD - Telecommand Fixed
FXE - Telemetering Fixed
FXH - Hydrologic and Meteorological Fixed
AX - Aeronautical Fixed

Emission Bandwidth (BDW)	
0 - 100 Hz	1%
50 - 800 kHz	25%
1 - 35 MHz	74%

Power (PWR)	
1 - 10 Watts	90%
20 Watts	7%
1 - 10 Kilowatts	3%

TX Antenna Gain (XAD)	
0 - 10 dBi	11%
24 - 40 dBi	83%
NO ENTRY	6%

Space Operation Service

ET - Space
TT - Earth

Emission Bandwidth (BDW)	
4 Hz	25%
40 MHz	75%

Power (PWR)	
.84 Watt	75%
2 Watts	25%

TX Antenna Gain (XAD)	
0 dBi	25%
XX(Less than 0 dBi)	75%

Space Research Service

EH - Space
TH - Earth

Emission Bandwidth (BDW)	
1 - 4 MHz	56%
6 - 20 MHz	22%
40 MHz	22%

Power (PWR)	
2 - 2.5 Watts	44%
3 - 5 Watts	44%
20 Watts	12%

TX Antenna Gain (XAD)	
0 - 1 dBi	57%
3 - 4 dBi	29%
XX (less than 0 dBi)	14%

No Specific Service

ED - Space Telecommand Space
EK - Space Tracking Space
ER - Space Telemetering Space
SN - Sounder Network
SP - Sounder Prediction
TD - Space Telecommand Earth
TK - Space Tracking Earth
TR - Space Telemetering Earth

Emission Bandwidth (BDW)	
0 - .95 MHz	16%
1 - 10 MHz	80%
10.91 - 50 MHz	4%

Power (PR)	
.003 - 100 Watts	76%
112 - 500 Watts	1%
1 Kilowatt - 1.6 Megawatts	23%

TX Antenna Gain (XAD)	
0 - 20 dBi	21%
26 - 41 dBi	32%
NO ENTRY	47%